eThekwini, South Africa

NEXUS opportunities at the Mariannhill Landfill Conservancy Plant

The eThekwini Municipality successfully limited human impact imposed on the environment through landfilling by creating a conservancy and a gas-to-energy plant inside the Mariannhill landfill. The initiative has the potential to revolutionize the way we think about landfills by seizing the opportunity to use them as a means to promote biodiversity and awareness, while reaping additional educational benefits for the community.

06 Urban NEXUS Case Study August 2014

Abstract

Conventional siloed approaches to waste management tend to focus on the disposal of waste as a singular and linear problem, often overlooking opportunities to link additional systems and services for enhanced resource efficiencies and co-benefits. The Mariannhill Landfill Conservancy represents a unique case of successfully integrated synergies between seemingly incompatible and pressing issues: waste management, electricity production, social equity and environmental preservation. The following case study illuminates eThekwini's process of harnessing multiple resources for enhanced integration and conservation in a successfully applied NEXUS of sectors and systems for the cascading of resources.

©Landill Conservancies, 2010

Date	1997-2024
Urban NEXUS Sectors	Waste-Environemnt-Energy-Social
Urban NEXUS Innovations	Design & Technology, Communication and Users Behaviors, Delivery Models, Institutions
Scale	Facility Project with Community Involvement
Budget	685.500 EUR (10 million ZAR)

Conventional solid waste management versus innovative NEXUS approaches

In our rapidly urbanizing world, sustainable solid waste management constitutes a key challenge faced by cities in the 21st century. The level of solid waste production has already reached a record high and is projected to increase by 70% by 2025 (World Bank, 2012). In most countries landfilling is still the standard method of dealing with solid waste. However, if unmonitored, landfilling activities result in great harm to the environment and neighboring communities. Waste decomposition not only produces greenhouse gas emissions through the anaerobic decomposition of organic matter, toxic chemicals can also leach into the soil, which contaminates surface and ground water bodies (World Bank, 2012). Thus, there is an urgent need for innovative solutions to address the growing production of solid waste.

©Landill Conservancies, 2010

Panoramic View over the landfill and plant conservation area.

Urban NEXUS Definition

The Urban NEXUS is an approach to the design of sustainable urban development solutions. The approach guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality.

It counters traditional sectoral thinking, trade-offs, and divided responsibilities that often result in poorly coordinated investments, increased costs, and underutilized infrastructures and facilities. The ultimate goal of the Urban NEXUS approach is to accelerate access to services, and to increase service quality and the quality of life within our planetary boundaries.

ICLEI / GIZ 2014

Urban NEXUS Case Study

eThekwini: a growing metropolis

In December 2000, the name of the city of Durban was changed to eThekwini and it acquired the status of a Metropolitan Municipality, hence broadening its border and administrative authority. This administrative change was part of the larger national post-apartheid context of institutional re-organization, aimed at recognizing regional functional interdependencies and redistributing resources to address inequalities between the relatively wealthy centers and the poorer peripheries. In an attempt to address the issue of institutional fragmentation, a single democratically elected municipal council was created in 2000 (Marx and Charlton, 2003). The metropolis of eThekwini has an estimated population of 3,442,361 inhabitants (2011, Census). It is the second largest metropolitan area in South Africa after Johannesburg with an economy centered on the manufacturing and tourism sectors.

In 2010 alone, the eThekwini Metropolitan Area produced over 1.8 million tons of waste, 1.4 million of which were deposited in three different landfills (DSW, 2011). Acting upon an increasing concern for the area's environmental sustainability, the national government set a target to reduce national GHG emissions by 30 million tons by 2015 (Winkler and Van Es, 2007).

Four in one: the case in which a landfill, community public space, conservancy and a power plant connect

The planning and implementation of the Mariannhill Landfill Conservancy project was done in a two-fold manner: the first stage of the project entailed the construction of a landfill and a conservancy on the same site, followed by the second phase, the construction of the leachate treatment plant and the gas-to-electricity power plant.

©UNEP 2013

Aerial view of the Mariannhill Landfill Conservancy Plant.

The first phase of the project is characterized by the integration of two distinctly different services and facilities: environmental conservation and waste management. In order to incorporate plant and species conservation activities onsite, one of the main components of the conservancy facilities is the Plant Rescue Unit, (PRUNIT) which ensures the immediate rehabilitation of land on closed landfill cells. The Plant Rescue Unit also monitors plant life within the entire landfill. When a cell is planned to open, the PRUNIT lists and relocates species into a similar environment. Upon the closing of a cell, the PRUNIT then ensures its complete rehabilitation. Typically in South Africa, the rehabilitation phase only intervenes after all the cells of the landfill fully close, which often happens decades after its opening. Therefore, at Mariannhill, rehabilitation is an on-going process, requiring iterative PRUNIT intervention.

The Red Data Species program monitors and controls endangered species present onsite via migration corridors and biological control systems. Following the requirements defined by the Conservancy's authority, facilities were implemented to enable staff members to perform the monitoring of wildlife inside the conservancy. The staff lists and monitors species present in the conserved area, including over 150 species of birds. The Conservancy's onsite education center, public walking trail and its tours increases public awareness and facilitate behavioral change.

In the second phase of the project, aiming at generating power from emitted landfill gas, a gas-to-energy power plant was constructed. The plant construction is part of a wider GHG emission reduction policy, which encompasses the collection of methane gas at two additional landfills in Durban.

In order to treat the collected waste leachate, a leachate treatment plant has been built on the site. The leachate treatment plant treats up to 50 cubic meters of leachate per day, helping to safeguard against soil and water contamination. The fully treated water is used for the irrigation of plants and to control landfill dust.

©Landill Conservancies, 2010

Leachate treatment plant with plant rescue bed

Leachate Treatment

The Mariannhill and Buffeldraai landfill sites have fully engineered and integrated leachate treatment plants, including engineered reedbeds, which treat between 50 and 200 m3/day of leachate respectively of varying biological strengths.

Urban NEXUS planning for integrated solutions

The Mariannhill Landfill Conservancy is the result of an institutional NEXUS and a high level of public participation. Precluding the Landfill Conservancy's implementation, the Department of Solid Waste planned to build a third landfill in the city at the location of Mariannhill, however, the project was met with strong resistance from residents and non-governmental organizations.

The Wildlife and Environment Society of South Africa (WESSA) was particularly active in fighting the project. In 1997, a full Environmental Impact Assessment (EIA) was completed and the Department of Solid Waste was granted the authorization to exploit the site despite public opposition.

In order to address popular concerns, the Solid Waste Department held a discussion with WESSA and commissioned a horticultural consultant to provide a project proposal to control the adverse consequences of waste management on the environment. Public consultation and collaboration between the DSW and WESSA helped reach a consensus among all parties involved and was key to realizing the project. The department of Solid Waste contemplated using landfill gas to electricity technology as early as 1994, yet the idea could not be concretized as it was not financially viable. The participation of South Africa in the Clean Development Mechanism (CDM), that has been created to finance projects aiming at reducing GHG emissions, was a turning point for the achievement of the gas-to-electricity plant.

©Landill Conservancies, 2010

Onsite gas to electricity plant

Gas to Energy Plant

The Marianhill gas to electricity plant functions through a proven technology of feeding the landfill gas into purpose-built spark-ignition engines each with a 500 KW to 1MW electricity generation capacity. The plant has a power generation capacity of 1-2-MW.

A multi stakeholder effort leads the way

The Durban Solid Waste Department (DSW) initiated and oversaw the construction of both components of the project, the conservancy and the gas-to-electricity plant. The DSW continues to own and operate the landfill site. Additionally, since the project's implementation the Monitoring Committee has been assisting the DSW in monitoring the site. The Monitoring Committee is composed of volunteers representing various stakeholders including residents and environmental organizations. The DSW worked side-by-side with civil society, notably WESSA, to design the conservancy side of the project. In the words of Deputy Head of the Engineering at Durban Solid Waste, John Parkin, "heated discussions" characterized WESSA-DSW relations, at first. However, such exchanges formed the basis for greater cooperation. After much discussion, Ezemvelo Kwa-Zulu Natal Wildlife, the governmental organization responsible for conservancies in South Africa, eventually granted the Mariannhill Landfill the status of a conservancy.

The gas-to-electricity plant project additionally benefited from the involvement of public-private partnerships. The Mayor personally led the negotiations with the World Bank, the responsible partner for the partial financing of the project, concerning the CDM.

The electricity produced at the Mariannhill power plant is managed by eThekwini Electricity, the municipal utility responsible for distribution, which usually buys most of the electricity from the public utility Eksom (eThekwini Municipality, 2011). In effect, the Mariannhill power plant presents a promising alternative to South African thermal, coal-fired power plants.

Results and impacts of the project in the community

The Mariannhill project has increased the City's waste disposal capacity. The landfill receives roughly 450 tons of waste daily, which corresponds to about 15% of the eThekwini Municipality's total daily waste production.

The project successfully controls environmental impacts of land filling. It avoids soil contamination and water pollution, which formerly heavily burdened the city's sewage system.

The gas-to-electricity plant reduces GHG emissions. For the year 2012-2013, emissions were reduced by 33,851 tons of CO2, while producing between 450,000 and 650,000 kWh of electricity per month, providing electricity for approximately 500 households (Impumelelo, 2007; Peter and Swilling, 2012).

The landfill has become an asset for the community. The project integrates local inhabitants in the management of the landfill conservancy through the Monitoring Committee. It increases social awareness about biodiversity and waste issues through weekly environmental lectures and regular visits from schools.

Community members help to chop wood

©Landill Conservancies, 2010

©Landill Conservancies, 2010

Visitors at a study tour around the landfill conservancy

Community involvement

Community involvement is one of the key assets of the landfill conservancy. Community members are involved in activities such as woodlot management. Educational tours through all the facilities onsite are another means to involve local people and raise awareness amongst the population.

Lessons learned

The success of the initiative lies in a conscious attempt to re-integrate segregated services, silos and systems with social and behavioral change. The project would have had a significantly different outcome, had it not been for the participation of extra-departmental experts, institutions and organizations at the early stages of the project's development. The capacity to think "outside the box" aided the design of an innovative solution and enabled the community to revolutionize what would have been a single sector issue and approach, to encompass a multi-sectoral solution which ultimately added greater benefit to the community.

The project benefited from diverse sources of funding, allowing the Solid Waste Department to expand the project and incorporate new elements. The application to the World Bank funded Clean Development Mechanism was a key element for the financing of the project and the integration of the energy department.

The strength of the project was the DSW's capacity to discuss challenges and opportunities with numerous stakeholders. Initially, the project was met with strong resistance from both local residents and environmental organizations. However, the project successfully integrated dissident voices into the design of the landfill to reach a win-win situation, satisfying all parties. The project kept its core function as a landfill depository, while eliciting additional positive effects on the environment, producing energy and enhancing social cohesion by providing the community with educational workshops and a new open public space.

The Solid Waste department had to fight in order to make the project happen, consequently the project suffered from bureaucratic difficulties. Firstly, senior management and budget committees from the municipality were reluctant to adopt the project. Conventionally, large funds had been allocated for rehabilitation only upon a landfill's closing. However, in the Mariannhill case, rehabilitation was an on-going process which implied shifting the funding model for landfill management. A second difficulty arose when the landfill sought to acquire the status of a conservancy. The Conservancies Authority, Ezemvelo Kwa-Zulu Natal Wildlife, initially believed the landfill could not become a conservancy. A great deal of discussion was needed to change this fundamental assumption. Only after it was acknowledged that the Mariannhill project was no different from an Industrial Conservancy, could the project be granted the title and the attached legal protection benefits of a conservancy. The absence of integration between silos would have considerably undermined the chances for a project of this nature to come to light.

Improving public, administrative and institutional awareness was crucial to the Mariannhill project's success. According to Deputy Head of the Engineering at Durban Solid Waste, John Parkin, "People do not understand waste management and are therefore suspicious of anyone or anything related to the subject matter. One has to build the relationship and the trust by getting senior management to buy in and thus obtain their support. Find suitably qualified people that can contribute to the team effort".

Replication

The project is replicable, provided that the managing authority establishes strong and long-lasting cross-sectoral and inter-departmental partnerships. The participation of extra-departmental experts and stakeholders including a horticultural consultant and organizations are key factors to reaching a win-win agreement. Monitored through a natural, efficient and low-cost treatment system, the landfill does not cost more than a conventional landfill (Impumelelo, 2007). The project is a successful solution to problems linked to solid waste management, with positive and long-lasting effects on both the environment and the surrounding communities.

"Running a landfill as a conservancy requires a mindset change and is hard work but the rewards are well worth it for the environment and from the conflict perspective. It is far more stressful being under siege than working with all involved in achieving a common goal," says John Parkin, Deputy Head of the Engineering at Durban Solid Waste.

Budget and finances

The Mariannhill Landfill Conservancy is one of the three landfills of the eThekwini municipality. The nearby gas-to-electricity power plant is part of a wider project whereby the three landfills are equipped with power plants. The total cost of the project including the three landfills is about R148.5 million (USD 14.15 million) for the eThekwini municipality until the landfills reach their full capacity (each has a lifespan of 21 years). The World Bank has additionally financed the project through the Clean Development Mechanism (CDM). Overall, the municipality should make a net profit of R56.9 million (USD 562,292) through the CDM, which will contribute to finance the Mariannhill conservancy's facilities (eThekwini municipality, 2006). The overall project costs no more than a conventional landfill (Impumelelo, 2007).

©Landill Conservancies, 2010

Red Data Species

The black headed dwarf chameleon is one of the red data species that is protected at the Marianhill Conservancy. Research on the species and a newly developed relocation protocol resulting in the successful preservation of the chameleon population has been approved by KZN Ezemvelo Wildlife.

Key Contacts

City of eThekwini
John Parkin
Deputy Head: Plant and Engineering Cleansing and Solid Waste
eThekwini Municipality, Durban, Africa
Tel: +27 31 311 8820
Email: John.Parkin@durban.gov.za

ICLEI World Secretariat (WS)
Capacity Center
Kaiser-Friedrich-Str. 7
53113 Bonn, Germany
Tel. +49-228 / 97 62 99-00
Fax +49-228 / 97 62 99-01
Email: urban.research@iclei.org
www.iclei.org/casestudies

The Urban NEXUS project 2013-2014 was funded by GIZ on behalf of BMZ to develop the "Operationalization of the NEXUS approach in cities and metropolitan regions".

The Urban NEXUS project included: a baseline study and report (GIZ and ICLEI, 2014), the identification and preparation of case studies and shorter case stories, and the design and implementation of action-oriented pilot projects supported by the German Development Cooperation.

ICLEI, as implementing partner of the Urban NEXUS project, is responsible for the content of this Case Study.

Further Reading:

GIZ and ICLEI, 2014, Operationalizing the Urban NEXUS: towards resource efficient and integrated cities and metropolitan regions. Available at: www.iclei.org/urbannexus

Acknowledgements

- Shella Patrickson, ICLEI Africa
- Author: Angèle Cauchois (Sciences Po-ICLEI Capstone Project)
- Editors: Kathrine Brekke, Lucy Price and Louisa Weiss, ICLEI World Secretariat
- Interviewees: John Parkin, Durban Solid Waste

Sources

- Monitoring Committee (official website): http://landfillconservancies.com/
- eThekwini Municipality (official website): http://www.durban.gov.za/Pages/default.aspx
- Marx, C. and Charlton, S. (2003), "The case of Durban, South Africa". UNDERSTANDING SLUMS: Case Studies for the Global Report on Human Settlements, UCL.
- http://www.ucl.ac.uk/dpu-projects/Global_Report/pdfs/Durban.pdf
- Strachan L.J. and Couth B. (2003), "Landfill gas to electricity project", DSW Unit
- http://www1.durban.gov.za/durban/services/cleansing/recycling/har
- "Sustainability Best Practice Portfolio 2005/6 - Special edition - Climate Change" from the eThekwini Municipality http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/Publications/Documents/Sustainability%20Best%20Practice%20Climate%20Change.pdf
- "Integrated waste management plan for eThekwini Municipality", Durban Solid Waste, August 2004, Document No. 2214/D0147
- http://www.durban.gov.za/Documents/CityServices/Cleansing%20and%20Solid%20Waste/Integrated_Waste_Management_Plan.pdf
- Impumelelo, 2007 "Mariannhill Landfill Conservancy", Impumelelo Magazine, 2006-2007 http://impumelelo.org.za/media/publications/marianhill-landfill-conservancy
- "Project Summary Document: Durban Landfill-to-electricity", Durban Solid Waste, 2004 http://www.kznenergy.org.za/download/projects/Durban_Landill-Gas_to_Electricity_22_Nov.pdf
- Winkler, H. and Van Es, D. (2007), "Energy efficiency and the CDM in South Africa: constraints and opportunities", Journal of Energy in Southern Africa, Vol. 18 No 1, February 2007.
- Camaren, P. and Swilling, M. (2012), Sustainable, Resource Efficient Cities – Making It Happen!. UNEP. http://www.usp.br/fau/cursos/graduacao/arq_urbanismo/disciplinas/aut0221/Material_de_Apoio/Cidades/Sustainableresourceefficientcities.pdf

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of: Federal Ministry for Economic Cooperation and Development

ETHEKWINI MUNICIPALITY

ICLEI Local Governments for Sustainability

This Case Study was elaborated for the Urban NEXUS project 2013-2014.

The ICLEI Case Study series is available at www.iclei.org/casestudies, and focuses on various types of urban sustainability activities of ICLEI Members and local governments that are part of ICLEI projects across the globe.

ICLEI – Local Governments for Sustainability is an international association of local governments implementing sustainable development. ICLEI's mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with special focus on environmental conditions through cumulative local actions.

© GIZ and ICLEI August 2014